Supplementary Submission No. 32-1
Rec'd 24Jun09

Inquiry into Long-term weather forecasting

ADDITIONAL MATERIAL

John McLean

'*The truth is ... the science of Nature has been already too long made only a work of the brain and fancy: It is now high time that it should return to the plainness and soundness of observations on material and obvious things*'

- Robert Hooke, English physicist of the 17th century, quoted in John Gribbin's "*Science a History*", Penguin Books, 2003

The pivotal chapter of the IPCC's Fourth Assessment (2007)
- was written by 53 authors
- most of whom were climate modellers
- more than 80% of which were in a network of people who had worked together
- 10 of whom were from the UK's Hadley Centre for Climate Prediction
- failed to produce quality evidence to support its claims

On the opinions of a clique of climate modellers Australia is heading for an ETS scheme that will cost billions, and the world spending ... the last figure I saw was trillions of US dollars. Doesn't that warrant more scepticism about the claims of climate modellers?

CONTENTS

1. Three figures that show the (in)accuracy of climate models

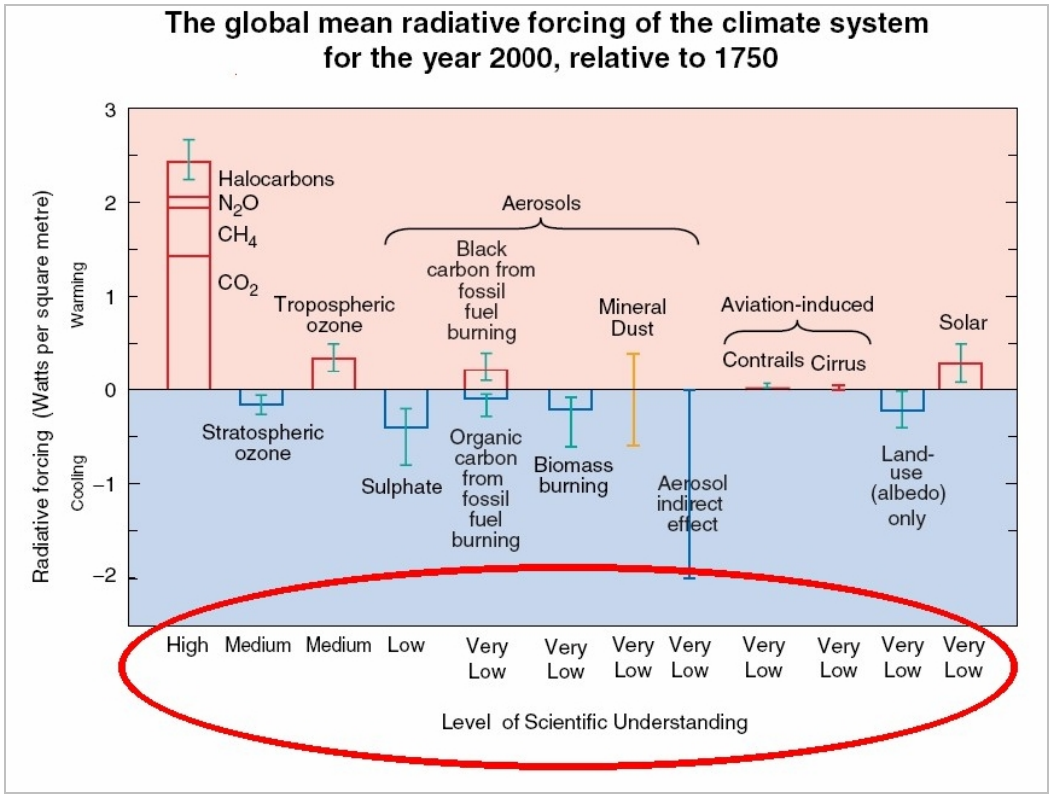

Figure S1.1 - Radiative forcing factors according to the IPCC TAR of 2001 (Third Assessment Report, Summary for Policymakers, Working Group I, Figure 3 and appearing elsewhere in the TAR in various forms). Note the low level of understanding of most components (circled here but not in the original).

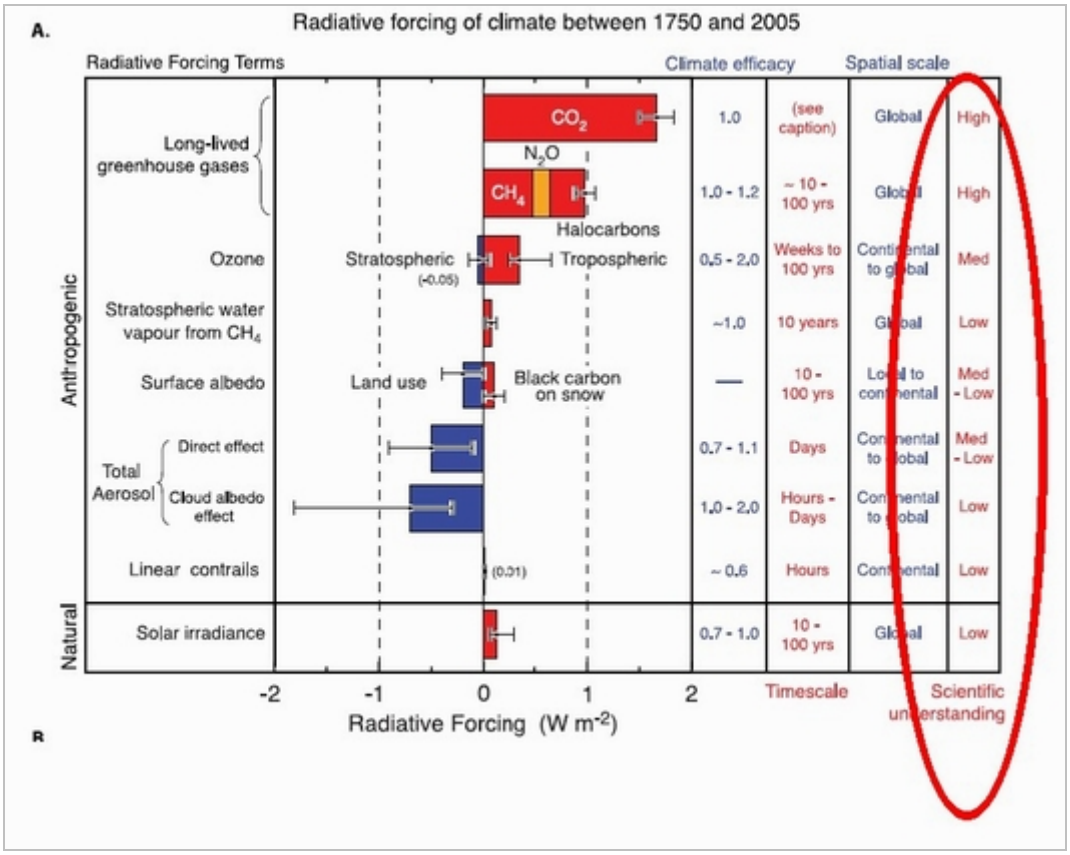

Figure S1.2 - Climate forcings as reported in the IPCC 4AR of 2007 (Fourth Assessment Report, Working Group I, Chapter 2, Figure 2.20). Notice that some items from 2001 have disappeared, where 12 were previously shown only 8 appear. The levels of scientific understanding (again circled her but not on the IPCC version) are still Low or Medium-Low on most, although that may be to try to convince us that the level of understanding is advancing.

How can we believe climate models when so many factors are poorly understood and therefore can't be modelled?

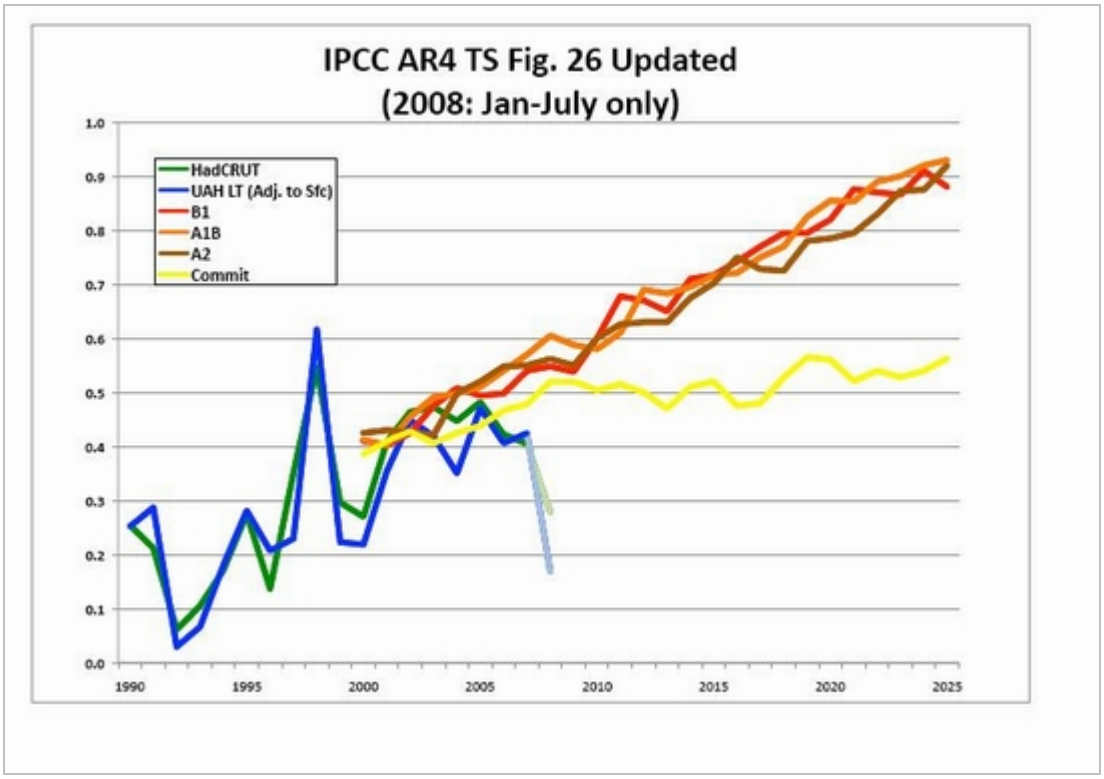

Figure S1.3 - (From John Christy.) Graphs of the projections of IPCC models (B1,A1B, A2 and commit) and the annual average temperature anomalies based on observations (HadCRUT and UAH LT).

(Actually the IPCC's graph lines are from a consensus of 22 models, but that doesn't prove anything because the models operate on similar principles and are all "tuned" to match 1950-1990 conditions as closely as possible - in other words it is predetermined that the models will generally agree.)

Why should we believe models when their performance is so poor? And that's despite billions of dollars poured into modelling over the last 20 years.

2. On the inaccuracy of recent UK seasonal forecasts

The Bureau of Meteorology has expressed a desire to move to modelling for its seasonal forecasts (i.e. next 3 to 5 months), like the UK's Met Office does. Do we really want forecasts as bad as the Met Office over the last few years?

Summer 2007

(a) Forecast

"Britain will sizzle in 100F" (9 April 2007, Sunday Express)[1]

BRITAIN is set for a summer heatwave with forecasters predicting scorching temperatures at record highs. As the country bathed in the Easter sunshine, experts were already expecting thermometers to soar to near the 100F (38C) mark in the hottest months. The Met Office's summer forecast, due out on Wednesday, is expected to reveal a 70 per cent chance that temperatures will exceed long-term averages – smashing even last year's sizzling highs.

Met Office forecast for summer 2007 (11 April 2007, Met Office)[2]

The latest seasonal forecast from the Met Office issued today, reveals that this summer is, yet again, likely to be warmer than normal.

Following the trend set throughout 2006 and the first part of 2007, seasonal forecasters say there is a high probability that summer temperature will exceed the 1971-2000 long-term average of 14.1 °C.

They also suggest the chances of temperatures similar to those experienced in 2003 and 2006 are around 1 in 8.

(b) What happened?

Summer 2007 summary (6 Sep 2007, Met Office)[3]

The main feature of the summer was the high rainfall experienced in many regions especially during June and July. It was the wettest summer for the whole of the UK since the rainfall series began in 1914. For England and Wales as a whole the summer has been the wettest since 1912. However, parts of north-west Scotland have been drier than normal.

The UK mean summer temperature was 14.1 °C which is the same as the 1971-2000 average. The UK average daily maximum temperature was just below average, whilst average daily minimum temperatures were just above average. It was the coolest UK summer since 1998.

Summer 2008

(a) Forecast

A Typical British Summer (3 April 2008, Met Office)[4]

Summer temperatures across the UK are more likely to be warmer than average and rainfall near or above average for the three months of summer.

---

[1] http://www.express.co.uk/posts/view/3933
[2] http://www.metoffice.gov.uk/corporate/pressoffice/2007/pr20070411.html
[3] http://www.metoffice.gov.uk/weather/seasonal/summer2007/index.html
[4] http://www.metoffice.gov.uk/corporate/pressoffice/2008/pr20080403.html

However, the risk of exceptional rainfall on the same scale as the summer of last year remains a very low probability.

(b) What happened?

Wet Summer could end with a Bang (29 Aug 2008, Met Office)[5]

Forecasters at the Met Office are predicting that that final day of the summer could end with heavy rain and thunderstorms affecting some parts of the country this weekend.
Very warm conditions with temperatures peaking at 27 °C in some southern and eastern areas of England are expected, although thunderstorms are likely to develop, mainly during Sunday.
The return to unsettled weather will mark the end of the meteorological summer which has been one of the wettest on record across the UK.

Summer 2008 (undated, Met Office)[6]

Mean temperatures for the UK were slightly above average for all 3 summer months. There was a notable contrast between maximum and minimum temperature during August, with maximum temperatures 0.5 °C below average and minimum temperatures 1.3 °C above average. The maximum temperatures for the UK for August were the same as August 2007, which had been the coolest since 1994.

All three summer months had above-average rainfall across the UK, with August being the wettest month. Well above-average summer rainfall across most areas, with parts of Northern Ireland and eastern Scotland having around double their average rainfall. In contrast, some areas of northern Scotland and south-east England had below average rainfall.

Three contrasting months for sunshine over the UK, with June being above average , July just below average and August having exceptionally below average sunshine. Summer sunshine levels were below average across most areas.

Winter 2008-09

(a) forecast

Trend of mild winters continues (25 Sep 2008, Met Office)[7]

The Met Office forecast for the coming winter suggests it is, once again, likely to be milder than average. It is also likely that the coming winter will be drier than last year.

(b) What happened?

Met Office issues press statements[8]

25 Nov - A cold start to winter
2 Dec - Cold weather to bring more snow
12 Dec - A cold start to winter
2 Jan - Cold weather to continue
9 Jan - Big Freeze round-up
30 Jan - Wintry start to February
2 Feb - Heavy snow causes disruption
4 Feb - Further snow to come for central Britain
6 Feb - Continuing cold

Coldest winter for a decade (25 Feb 2009, Met Office)[9]

---

[5] http://www.metoffice.gov.uk/corporate/pressoffice/2008/pr20080829b.html
[6] http://www.metoffice.gov.uk/climate/uk/2008/summer.html
[7] http://www.metoffice.gov.uk/corporate/pressoffice/2008/pr20080925.html
[8] see http://www.metoffice.gov.uk/corporate/pressoffice/2008/index.html for those in 2008 and http://www.metoffice.gov.uk/corporate/pressoffice/2009/index.html for those in 2009
[9] http://www.metoffice.gov.uk/corporate/pressoffice/2009/pr20090225.html

> Mild weather is expected to see out what remains of winter. Despite this, it is expected to be the coldest UK winter since 1995/96, according to provisional Met Office figures.
>
> The low temperatures have also been accompanied at times by heavy snow. During early February, the heaviest snowfall for 18 years was experienced over many areas of the UK.

The impact of this poor winter forecast was very serious - a shortage of salt for dealing with the snow and ice on Britain's roads. The Daily Telegraph of 5 Feb 2009[10] put it...

> Councils are having to ration grit use and suppliers are working round the clock but still cannot produce enough salt to cope with demand. Many fear they could run out by the weekend. Forecasters have warned that the freezing blast will continue through next week raising concerns that if the grit runs out then the country will not be able to cope. The AA has now called on the Government to step in and ensure that salt stocks are maintained over the coming days.
>
> Edmund King, of the AA, said: "The harshest winter for almost two decades has left some highway authorities 'running on empty' as regards their salt stocks. Many are desperate to re-stock their road salt but supply chain pressures from mine to highway depot looks like resulting in some areas running dry – this is a very serious situation with some roads becoming death traps."

And The Times[11] reported on traffic accidents and school closures caused by lack of preparation for the cold weather.

Summer 2009 (i.e. current)

(a) forecast

> **Summer forecast 2009** (30 Apr 2009, Met Office)
>
> The coming summer is 'odds on for a barbecue summer', according to long-range forecasts. Summer temperatures across the UK are likely to be warmer than average and rainfall near or below average for the three months of summer.
>
> Chief Meteorologist at the Met Office, Ewen McCallum, said: "After two disappointingly-wet summers, the signs are much more promising this year. We can expect times when temperatures will be above 30 °C, something we hardly saw at all last year."
>
> Although the forecast is for a drier and warmer summer than average it does not rule out the chances of seeing some heavy downpours at times. However, a repeat of the wet summers of 2007 and 2008 is unlikely.

(b) ... and so far (to 21 June)

The Met Office has issued the following statements[12]

- Heavy Rain over weekend 6 to 7 June 2009
- Heavy Rain on 10 and 11 June 2009
- Thunderstorms and heavy rain on 13 to 15 June 2009

---

[10] http://www.telegraph.co.uk/topics/weather/4526489/Snow-brings-travel-chaos-as-Government-urged-to-take-action-over-grit-shortage.html

[11] http://www.timesonline.co.uk/tol/news/uk/article5668236.ece

[12] http://www.metoffice.gov.uk/corporate/pressoffice/2009/index.html

Maybe you wonder if the Met Office has been using mathematical models for its seasonal forecasts given that the accuracy is so poor. The following extract from a Met Office Publication[13] makes it quite clear that this is the method:

> **How are the forecasts produced?**
> The same computer models of the atmosphere that are used to make the daily weather forecasts are used, with some differences:
> - they are run forward in time up to many months ahead, rather than just for a few days
> - active oceanic, as well as atmospheric, components are included
> - they are run many times, with slight variations to represent uncertainties in the forecast process
>
> We occasionally use statistical forecasting methods on the seasonal timescale — in winter and summer for UK and Europe. This is done where physical relationships between weather and the state of the oceans have been found, but where models do not yet show sufficient skill to pick up these particular relationships. This gives rise to a mixed statistical and physical model forecast process.

The Met Office has just installed a new £30 million computer[14], rated in the top 20 in the world, for its weather forecasting but will it do much more than produce inaccurate forecasts faster?

If the Bureau of Meteorology shifts to models for its seasonal forecasts will its accuracy be any better than the UK's Met Office?

If not, will it likewise then say that it needs a more powerful computer?

---

[13] from http://www.metoffice.gov.uk/science/creating/monthsahead/seasonal/
[14] http://www.itpro.co.uk/610965/met-office-gets-30-million-supercomputer

3. Climate Models do not meet forecasting standards

from Canada's "Financial Post" at
http://network.nationalpost.com/np/blogs/fpcomment/archive/2009/06/16/junk-science-week-mit-s-unscientific-catastrophic-climate-forecast.aspx

Junk Science Week: MIT's unscientific, catastrophic climate forecast
Posted: June 16, 2009, 7:56 PM by NP Editor

The MIT modellers violated 49 principles of forecasting

By Kesten C. Green and J. Scott Armstrong

When we drive on a long bridge over a river or fly in a passenger aircraft, we expect the bridge and the plane to have been designed and built in ways that are consistent with proven scientific principles. Should we expect similar standards to apply to forecasts that are intended to help policymakers make important decisions that will affect people's jobs and even their lives? Of course we should. Such standards exist. But are they being followed?

The *Financial Post* asked us to look at a report last month from the Massachusetts Institute of Technology (MIT) Joint Program on the Science and Policy of Global Change, titled "Probabilistic Forecast for 21st Century Climate based on uncertainties in emissions (without policy) and climate parameters."

The MIT report authors predicted that, without massive government action, global warming could be twice as severe as previously forecast, and more severe than the official projections of the United Nations' Intergovernmental Panel on Climate Change (IPCC). The MIT authors said their report is based in part on 400 runs of a computer model of the global climate and economic activity.

While the MIT group espouses lofty-sounding objectives to provide leadership with "independent policy analysis and public education in global environmental change," we found their procedures inconsistent with important forecasting principles. No more than 30% of forecasting principles were properly applied by the MIT modellers and 49 principles were violated. For an important problem such as this, we do not think it is defensible to violate a single principle.

For example, MIT forecasters should have shrunk forecasts of change in the face of uncertainty about predictions of the explanatory variables; in this case the variables postulated to influence temperatures. More generally, they should also have been conservative in this situation of high uncertainty and instability. They were not.

We recognize that judgement is required in rating forecasting procedures. Evidence for our principles, however, is in the form of findings from scientific experiments comparing reasonable alternative methods, and accepted practice (see our site[15]).

So what's really wrong with the MIT report? The phrase "global environmental change" provides a clue. The group's objective implicitly rejects the possibility of no or unimportant change or, despite mention of uncertainties, the possibility of unpredictable change. People who do research on forecasting know that a forecast of "no change" can be hard, if not impossible, to beat in many circumstances. A forecast of no change does not mean that one should necessarily expect things not to vary. Such a forecast can be appropriate even when a great deal of change is possible but the direction, extent or duration is uncertain.

[15] http://forecastingprinciples.com/

When one looks at long series of Earth's temperatures, one finds that they have gone up and down irregularly, over long and short periods, on all time scales from years to millennia. Moreover, science has not been able to tell us why. There is much uncertainty about past climate changes and about the strength and even direction of causal relationships. To wit, do warming temperatures result in more carbon dioxide in the atmosphere or is it the other way round — or maybe a bit of both? Does warming of the atmosphere result in negative or positive feedback from clouds? There are many more such questions without answers. All this strongly suggests that a no-change forecast is the appropriate benchmark long-term forecast.

With Dr. Willie Soon of the Harvard-Smithsonian Center for Astrophysics, we found that simply predicting that global mean temperatures will not change results in quite small forecast errors. In our validation study that covered the period 1851 to 2007, we compared the no-change forecast with the IPCC global warming forecast that temperatures will climb at a rate of 0.03C per year. We compared the IPCC projection of 0.03C per year with what actually happened after 1850. The errors from the IPCC projection were 12 times larger than no-change benchmark. Consider the accuracy of the no-change model: On average the 50-years ahead forecasts differed by only 0.24C from the global mean temperature as measured by the Hadley Centre in the U.K.

Based on our analysis, we expect the annual global mean temperature for every year for the rest of the 21st Century to be within plus-or-minus 0.5C of the 2008 mean.

The MIT approach to forecasting is in substance the same as the approach adopted by the IPCC. Our forecasting audit of the IPCC approach and its conclusion therefore applies as well to the MIT forecasting effort: The forecasting procedures were not valid and there is no reason for policymakers to take their forecasts seriously. It also leads to the conclusion that the MIT forecast errors will be much larger even than the IPCC's forecast errors.

Policymakers and the public should be made aware that the forecasts from the MIT modellers, as well as those used by the IPCC, are merely the opinions of some scientists and computer modellers. It is not proper to claim that these are truly scientific forecasts.

Financial Post

Dr. Kesten C. Green is a senior research fellow of the Business and Economic Forecasting Unit at Monash University in Australia. Dr. J. Scott Armstrong is Professor of Marketing at The Wharton School, University of Pennsylvania. Armstrong and Green are co-directors of the public service Web site forecastingprinciples.com, sponsored by the International Institute of Forecasters.

See also

Green and Armstrong's website http://publicpolicyforecasting.com/

Green, K. C., Armstrong, J. S., & Soon, W. (2009). Validity of climate change forecasting for public policy decision making. *International Journal of Forecasting*, forthcoming. (already available at http://kestencgreen.com/naiveclimate.pdf)

Extract - "Finally, success in forecasting climate change and the effects of climate change must then be followed by valid forecasts of the effects of alternative policies. And, again, one would need benchmark forecasts; presumably based on an assumption of taking no action, as that is typically the least costly. ... The problem is a complex one. A failure at any of one of the three stages of forecasting—temperature change, impacts of changes, and impacts of alternative policies—would imply that climate change policies have no scientific basis."

****

4. Article questioning the value of climate models

Climate is always changing for a variety of reasons and Roger Pielke Jr. argues that this constant variability - lack of stationarity (see footnote) - will defeat any attempt to model climate.

from http://sciencepolicy.colorado.edu/prometheus/collateral-damage-from-the-death-of-stationarity-5508

Collateral Damage from the Death of Stationarity

June 10th, 2009

Posted by: Roger Pielke, Jr.

In recent years climate scientists have come to understand that the climate system may not be stationary[16] - meaning that the fundamental statistics of climate vary and change over timescales of relevance to people. For those who consider that the phrase "climate change" is redundant, this will be no surprise. However, decision makers in a wide range of settings, including flood mitigation, reinsurance and insurance, and even aspects of carbon policy, operate from a framework where climate is perceived to be a stationary process.

In a new essay in the GEWEX Newsletter I argue that if indeed stationarity is dead then collateral damage of the new philosophy of climate necessarily must be the notion that we can ever evaluate the skill of climate predictions using empirical methods. That leaves us relying on a few remaining methods of forecast evaluation, among them political expediency and simple faith.

Here is an excerpt from my essay:

> Here I suggest a far more consequential implication of the death of stationarity for the role of science in water management decision making than a need for better models and observations. Rather than basing decision-making on a predict (probabilistically of course) then act model, we may have to face up to the fact that skillful prediction of variables of interest to decision makers may simply not be possible. And even if it were possible, we would not be able to identify skill on the same time scales as decisions need to be made. The consequence of this line of argument is that if stationarity is indeed dead, then it has likely taken along with it fanciful notions of foreseeing the future as the basis for optimal actions. Instead, it may be time to rethink how we make decisions in the face of not simply uncertainty, but fundamental and irreducible ignorance. Rather than focus on optimal decisions guided by prediction, we may need instead to focus on robust decisions guided by recognition of the limits of what can be known.

You can read the entire essay, which includes an excursion into how the "guaranteed win scam" conspires with the "hot hand fallacy" to defeat efforts to judge predictive skill in the context of nonstationarity, at the link below.

Pielke, Jr., R.A., 2009. Collateral Damage from the Death of Stationarity, GEWEX Newsletter, May, pp. 5-7. (PDF)[17]

---

[16] "In the mathematical sciences, a stationary process (or strict(ly) stationary process or strong(ly) stationary process) is a stochastic process whose joint probability distribution does not change when shifted in time or space. As a result, parameters such as the mean and variance, if they exist, also do not change over time or position." - from http://en.wikipedia.org/wiki/Stationary_process

[17] http://sciencepolicy.colorado.edu/admin/publication_files/resource-2725-2009.11.pdf

5. A question of data quality

Climate models are tested against observational data but what if local influences impact the temperatures measured at observation stations?

The "official" data is what the observers record and notes are supposed to be kept to record any changes to the local environment.

- Are those records kept?
- Are they up to date?
- Are they used to modify temperatures prior publication or use in models?

Here are three examples, all part of the Bureau of Meteorology's "reference network" of stations with high quality data and long records

(a) Cape Nelson (Vic)

A high stone fence, a building maybe 5 metres north of the instruments and worst of all, coastal scrub that would block southerly winds (see figures S5.1 and S5.2).

Has the coastal scrub always been there or has it grown over time and progressively shielded the station from winds? If the latter is correct then has any compensation been applied to the data?

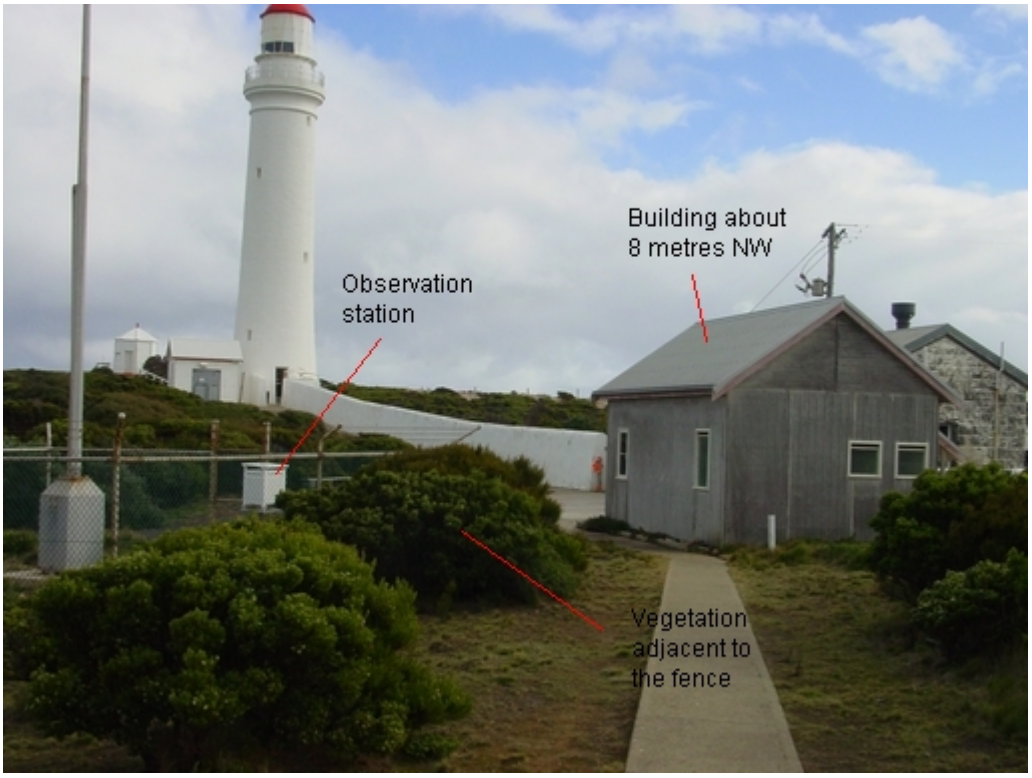

Figure S5.1 - Cape Nelson automatic weather station from the east

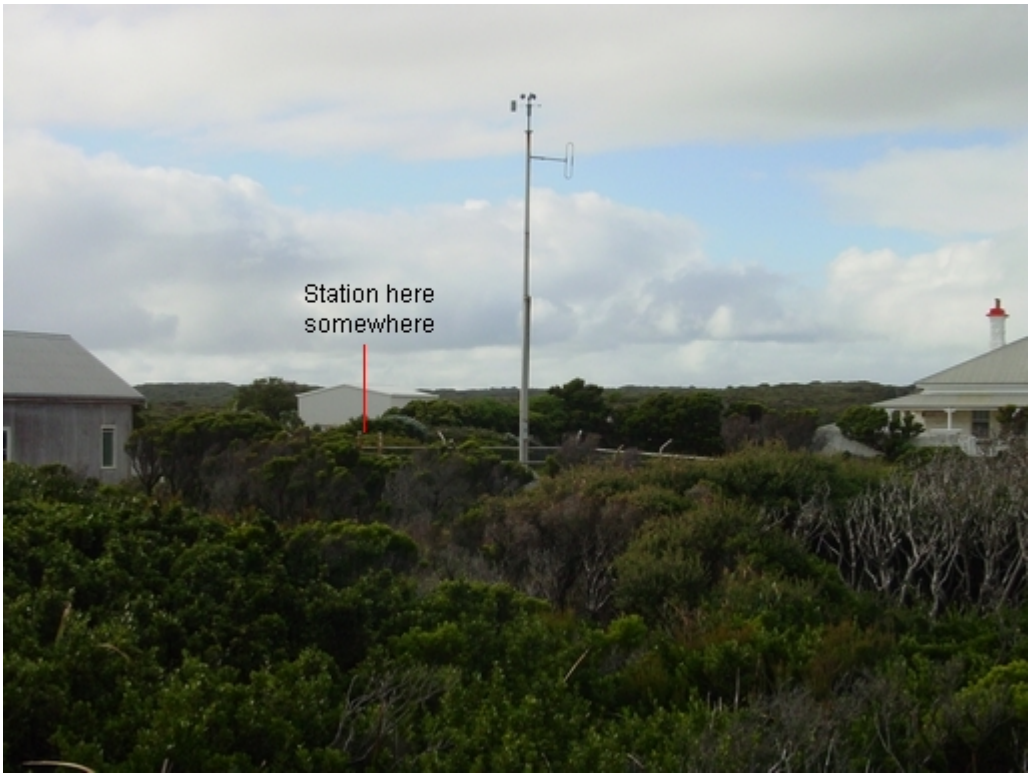

Figure S5.2 - Cape Nelson station from the south at a height of about 1.5 metres. Somewhere hidden behind that scrub is the automatic weather station.

(b) Laverton, (Vic)

This observation station was originally at a busy airforce base but over time the base has slid into gradually into disuse. The airforce base was once in open country to the west of the town of Laverton and apart from the aerodrome buildings only the town might have caused any distortion.

Now the former airforce base has a substantial housing development to the south, and a steady encroachment from the south-west. Added to that we have an increase in road traffic (Geelong Rd) and rail traffic (to Geelong and now via the standard gauge track, to Adelaide).

Have Laverton's temperatures been adjusted to take into these changes to the local environment into account?

(c) Nhill (Vic)

Nhill has two observation stations. The first was about 3 km north of the town at an airstrip that was a busy place during World War II. After the war the airstrip fell into very minor use and, following complaints by the observer about the travel and the twice-daily disruption from whatever he or she was doing, about 20 years ago the observation station, using a Stevenson screen was moved to the south-west edge of the town (fig S5.3) and an automatic weather station replaced it at the airport (fig S5.4).

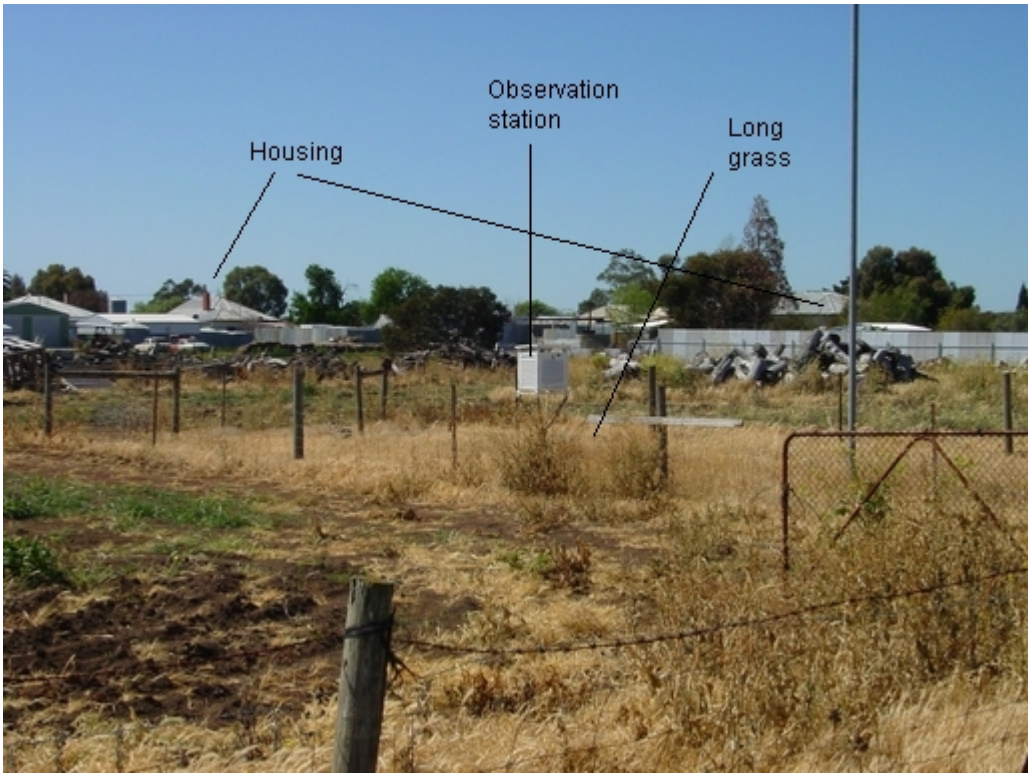

Figure S5.3 - Manual instrument, part of the reference network, on the edge of Nhill township

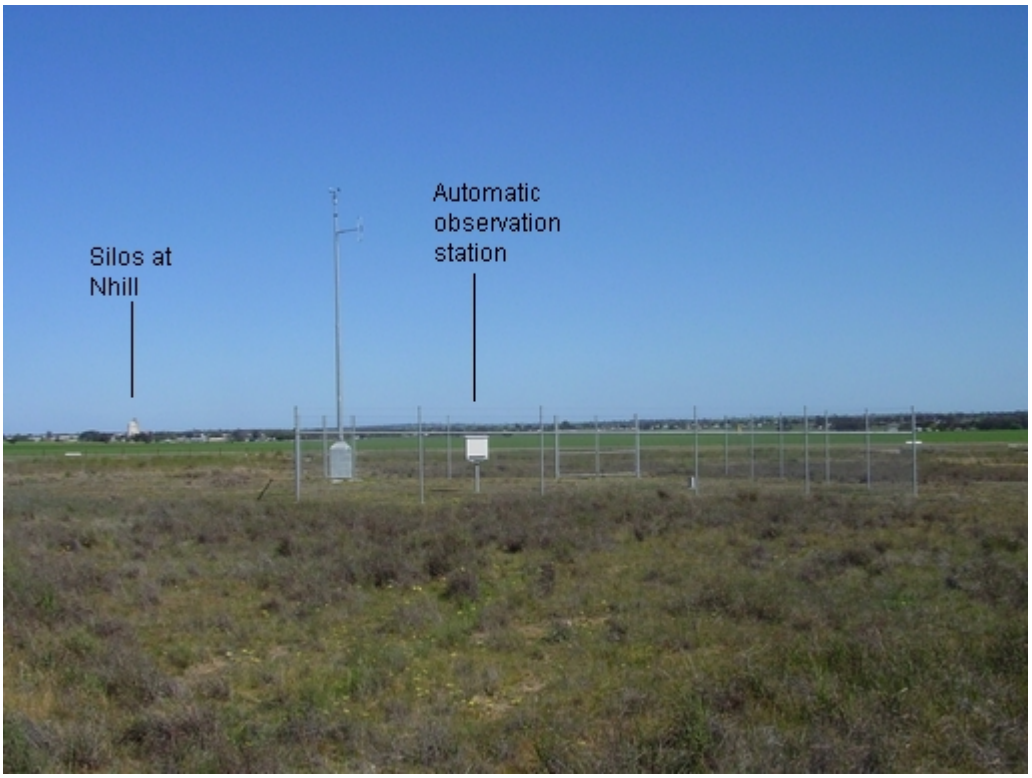

Figure S5.4 - The automatic weather station at Nhill airstrip.

The data for these two stations[18] from April to December 2008 are shown in table S5-1(a) and (b)below.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aerodrome				21.8	17.6	15.7	13.3	13.8	18.9	24.1	25.2	25.7
Town	31.2	28.0	31.0	21.7	17.3	15.4	13.1	13.4	18.6	23.8	24.9	25.4

Table S5-1(a). Mean Maximum temperatures at Nhill

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aerodrome				7.6	6.1	6.2	4.2	3.6	5.2	6.9	9.8	11.4
Town	14.0	11.0	11.3	5.7	5.2	5.6	3.3	2.7	3.7	5.5	9.1	10.9

Table S5-1(b) Mean Minimum temperatures at Nhill

Over the 9 months for which data is easily available mean maximum temperatures from the aerodrome were 0.28 C higher than from the observation station at the edge of town. The greatest difference is in the mean minimum temperatures for the month with those from aerodrome averaging 1.03C greater and the difference in April being 1.9C. These minimum temperatures are shown the figure S5.5.

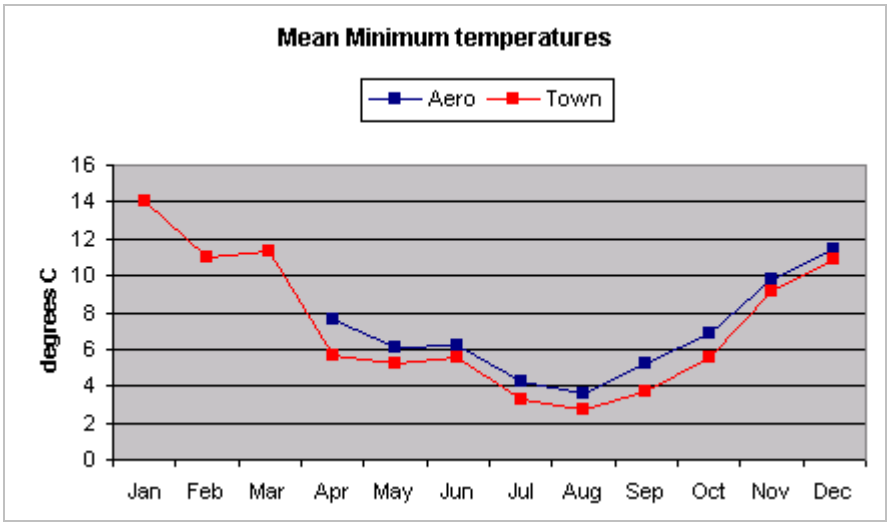

Figure S5.5 - Monthly mean minimum temperatures at Nhill aerodrome and Nhill township.

The implications of this difference are interesting and important.

If both stations are accurate for their location ... then the move into Nhill caused a shift in the data that requires compensation if we are to sensible compare data that spans the time of the move of the observation station.

If the temperatures are supposed to be the same in each location ... then the instruments are reporting quite different values for the same temperature. That brings into question the impact of replacing manual observations with automatic weather stations. Research by the Bureau of Meteorology indicates that there is a small difference but that might be based on broad averages rather than seasonal variations or, as shown here, minimum and maximum temperatures.

[18] Data for Nhill aerodrome AWS was obtained from the Bureau of Meteorology website for Victoria (http://www.bom.gov.au/weather/vic) then "all Observation", then "Victoria", then "Nhill Airport", then "Recent months at Nhill Aerodrome" and at the foot of that page access the relevant month in 2008.

The data for Nhill was obtained via webpage http://www.bom.gov.au/climate/averages/tables/cw_078031.shtml, then draw a graph of mean maximum temperature (or mean mininum), then for comparison select 2008 and the monthly data will be shown.

Conclusion:

Before worrying about the accuracy of the CSIRO's climate models perhaps we need to be more concerned about the accuracy of the temperature data being fed into them.

These three stations raise some serious questions about the integrity of temperature data as the environments alter around them. It seems unlikely that these three stations, all in the western half of Victoria will be the only stations for all of Australia to be suffering from dynamic environments. Have the environments at other stations also changed over time? Has vegetation changed and altering shadow and/or wind patterns? Have buildings altered the flow of air or are they now reflecting sunlight towards these stations? Are there any local sources of heat (e.g. air conditioning or flues) nearby?

The Bureau of Meteorology likes to remind us that Australia has been warming but it will look rather foolish if the supposed warming is very largely due to changes in the environments around the monitoring stations.

What is the situation with the CSIRO's climate models? These models are manually "tuned" to match historic temperature patterns as closely as possible but if that temperature data is wrong then the whole exercise is rather pointless - no, worse than that, certain factors might be assumed to play a greater role than they do play and any predictions of future climate are skewed by the influence of these factors.

Whatever else climate models might do or not do, it is patently obvious that if they have worked from incorrect data there's no way that we should accept the output as somehow being accurate.